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VOL. XIV, No. 8 WASHINGTON AUGUST, 1903

THE NATIONAL GEOGRAPHIC MAGAZINE

THE UNITED STATES: HER INDUSTRIES*

BY O. P. AUSTIN,

CHIEF OF BUREAU OF STATISTICS, DEPARTMENT OF COMMERCE AND LABOR

THE progress of the United States in its material industries has been the surprise of the whole world, the pride of her affectionate citizens. From a handful of five million people at the beginning of the last century she has grown to eighty millions, and from the smallest of beginnings she has reached the head of the list in agriculture, in mining, in manufacturing, in currency, and in wealth.

The purpose of this series of lectures is to present to you a picture of the growth of our common country, a picture of a century of unparalleled development—a development before which the world stands in amazement. No such record is known to history; no such development has occurred within so short a period; no such height has been attained in invention, in science, and in their application to the affairs of daily life, the life of the masses. While all nations have shared, in a greater or less degree, in the progress and prosperity of the century, the United States has enjoyed an especially large share of both, and made a record of which her citizens may well be proud.

To the first lecture of this series was assigned the story of the great natural resources and advantages of the country, and to the second the history of the development of our great agricultural resources. Both of these have been presented.†

To me has been assigned the subject of the industrial wealth of the nation, the development of the conditions which have made this the greatest manufacturing as well as the greatest producing nation.

And no subject could be more welcome, more inspiring to the student of the development of our country and its material resources. To trace the growth of our manufacturing interests from a total of 200 million dollars in 1810 to 13,000 millions in 1900, and the advance of the United States from the bottom of

*An address before the National Geographic Society, February 25, 1903.

†"The United States—Lands and Waters," Cyrus C. Adams, NATIONAL GEOGRAPHIC MAGAZINE, May, 1903; "The United States—The Soil and Its Products," NATIONAL GEOGRAPHIC MAGAZINE, July, 1903.

the list of great manufacturing nations to the very head of that list, is a task which fully compensates the student, in a renewed admiration for the history of our people and a renewed faith in their future.

The first attempt at a census of manufactures in the United States was in 1810, when the total value was found to be, in round terms, $200,000,000. The census figures of manufactures in 1820 and 1830 were incomplete, but those of 1840 were about a half billion dollars; those of 1850, about one billion; 1860, nearly two billions; 1870, over four billions; 1880, about 5½ billions; 1890, more than 9 billions, and 1900, 13 billions. The actual increase from decade to decade, still speaking in round terms, was: from 1850 to 1860, nearly one billion dollars; 1860 to 1870, over two billions; 1870 to 1880, one billion; 1880 to 1890, four billions, and 1890 to 1900, 3½ billions. In round terms, it may be said that the growth in the first half of the century was one billion, and in the second half 12 billions of dollars.

The slow growth in the first half of the century is due in part to the fact that a large share of the manufacturing was still performed in the household. While the factory system of manufacture began to take the place of that of the household in England in the closing years of the 18th century, especially as related to textiles, it did not obtain a foothold in the United States until during the period of the embargo and the War of 1812, and it was not until about 1840 that it became general; and as late as the middle of the century a considerable share of the manufacturing was still carried on in the family or in the small shop by the aid of the family and apprentices, as distinguished from the factory with paid employés and the application of power. Hence it is not surprising that the census of 1850 showed manufactures amounting to but one billion dollars' value, while the chief cause for astonishment is the wonderful growth which has occurred since that time—a growth from one billion dollars in 1850 to 13 billions in 1900.

I shall therefore confine my analysis of the growth of manufactures and its causes chiefly to the last half of the century, and in this I rely largely upon some charts and diagrams, by the use of which the eye may aid the mind in readily comparing the relative figures which mark the stages of growth. Necessarily the figures of manufactures as a whole can only be stated at decennial periods, for it is only by the national census that this great task of measuring the operations of the national workshop is undertaken, and I am proud to say that the United States takes this measurement much more effectively and more in detail than any other nation of the world.

Before beginning this analysis, I will say in general terms that the census figures show that the number of manufacturing establishments has grown from 123,025 in 1850 to 512,339, or four times as many in 1900; the sums paid in salaries and wages, from $236,755,464 to $2,732,821,528, or 12 times as much as in 1850, and the value of the manufactures from $1,019,106,616 to $13,039,279,566, or 13 times as much as in 1850.

It is proper to add that the figures of the total value of manufactures are merely an aggregation of the values reported by all manufacturers, and as the products reported by one manufacturer often become the materials for use by others, the figures of the grand total are to that extent duplications. For example, the leather reported as a manufacture by the tanner becomes the material used by the manufacturer of boots and shoes, and is a second time reported by him in stating the value of the manufactures turned out. The yarn produced by one manufacturer becomes

the manufacturing material for the maker of cloth, and the cloth becomes the material used by the manufacturer of clothing, the value of the yarn being thus reported three times, and that of the cloth twice, in the final statement of the grand total of manufactures produced. But as this custom has been followed in each census it does not materially affect the value of the figures for comparative purposes in showing the growth of the manufacturing industry. On the other hand, the fact that values of manufactures have greatly fallen since the earlier dates considered indicates that the actual increase in quantity produced is even greater than that indicated by the figures, which necessarily deal with values only.

With this basis of necessary statistical data I shall try to present the remaining facts and analyses in a manner in which the growth may be measured with the eye as well as the ear, and conclusions thus more readily reached as to the growth and cause of this growth, in which we all feel such a just pride.

No. 1.—VALUE OF MANUFACTURES OF THE UNITED STATES, 1810 TO 1900

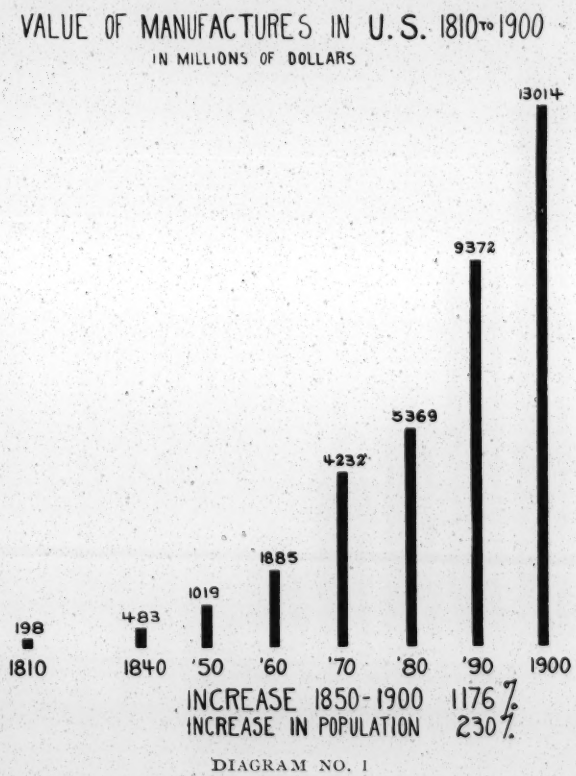


DIAGRAM NO. 1

The length of the lines here presented indicates the relative value of the manufactures of the United States in 1810 and in each census year, beginning with 1840. It will be observed that the first great increase was in the decade 1860–1870; the second, from 1880 to 1890. It is well known that the civil war conditions, the exceptional home demand, and the difficulties of importation greatly stimulated manufacturing during the period 1860–1870, and the fact that the production of 1870 was stated in an inflated currency also probably accounts in some degree for the high figure of that year, and also for the fact that the apparent increase in the next decade was small. The second great increase, from 1880 to 1890, was due to the opening of the interior by railways, by which the natural products were easily assembled for manufacture, the great reduction in cost of transportation, the enormous investments of capital in manufacturing, and the application of labor-saving machinery to much which was formerly performed by hand. In the decade from 1890 to 1900 came the enormous expansion in our exports of manufactures, from 151 millions in 1890 to 433 millions in 1900, and the organization of great industrial combinations by which cost of manufacturing and

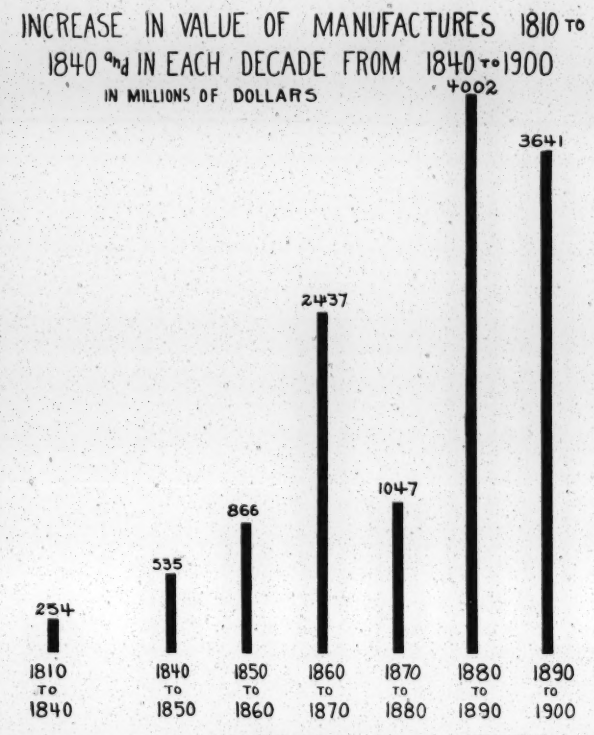


DIAGRAM NO. 2

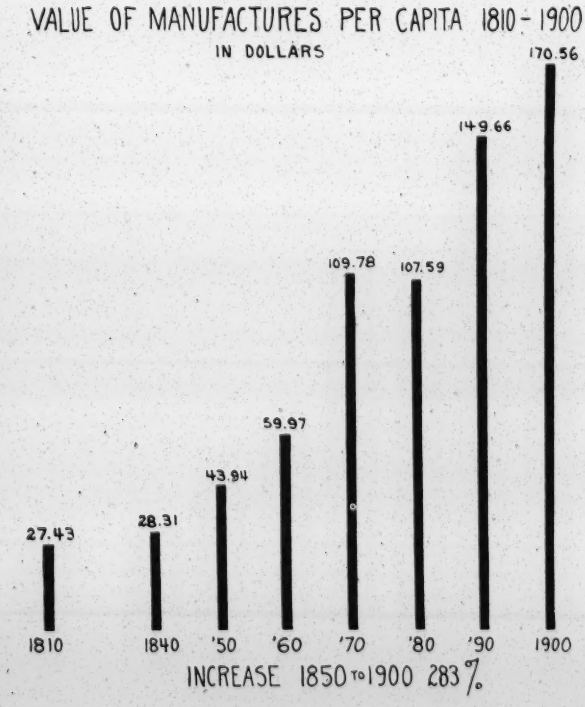


DIAGRAM NO. 3

handling was further reduced and production greatly stimulated.

No 2.—INCREASE IN VALUE OF MANUFACTURES, 1810 TO 1840, AND IN EACH DECADE FROM 1840 TO 1900

This shows the actual increase in the value of manufactures reported in each census year, as compared with its predecessor, and confirms what has just been said relative to the growth in the decades 1860–1870 and 1880–1890 and 1890–1900.

No. 3.—VALUE OF MANUFACTURES PER CAPITA, 1810 TO 1900

The very great increase in population suggests, of itself, a great increase in manufacturing, and it is therefore proper to show the value per capita of the manufactures of the United States in each census year. It will be seen that the value of manufactures reported in 1810 and 1840 averaged about $28 per capita, and are now about $170 per capita, or three times as much for each individual at present as in 1860, four times as much as in 1850, and six times as much as in 1840. This indicates that the per capita value of manufactures consumed by the masses has increased at about this rate, as 97 per cent of the manufactures are consumed at home, while the fact that prices have greatly fallen meanwhile indicates that the quantity consumed is probably five times as much per capita as in 1860 and ten times as much as in 1840.

No. 4.—NUMBER OF PERSONS IN EACH 1,000 ENGAGED IN MANUFACTURING AND AGRICULTURE, 1870 TO 1900

This shows the number of persons in each 1,000 engaged in manufacturing and agriculture, respectively. It will be seen that the number engaged in manufacturing has increased from 53 per thousand to 74 per thousand, an increase of 40 per cent since 1870, while

the number engaged in agriculture has decreased from 152 to 135 per thousand, a decrease of 12½ per cent, in the same time, showing the trend of labor from agriculture to manufacturing.

NUMBER OF PERSONS IN EACH 1000 ENGAGED IN MANUFACTURING AND AGRICULTURE 1870 TO 1900

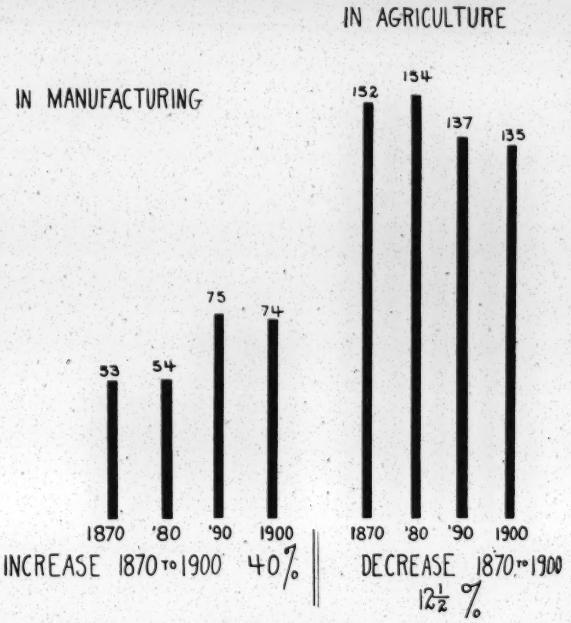


DIAGRAM NO. 4

No. 5.—TOTAL NUMBER OF PERSONS ENGAGED IN MANUFACTURES AND AGRICULTURE, RESPECTIVELY, 1870 TO 1900

While there is no desire to measure the growth of manufacturing by that of any other industry or make invidious comparisons, it seems not improper to call attention to the relative growth of the manufacturing industry as compared with agriculture, which was formerly considered the chief occupation of the people of the United States, and which still furnishes two-thirds of our enormous exportations. This diagram shows the actual increase and percentage of increase in the total number of persons engaged in manufactures and agriculture respectively, and their relative growth in the past 30 years. It will be seen that those engaged in manufacture have increased from 2 millions to over 5½ millions, and those in agriculture from about 6 millions to 10½ millions, and that while twice as many persons are still engaged in agriculture as in manufacture, the relative growth has been much more rapid in the manufacturing industry. The number engaged in manufactures have nearly trebled, while the number engaged in agriculture has not quite doubled.

TOTAL NUMBER OF PERSONS ENGAGED IN MANUFACTURES AND AGRICULTURE RESPECTIVELY 1870 TO 1900 IN MILLIONS

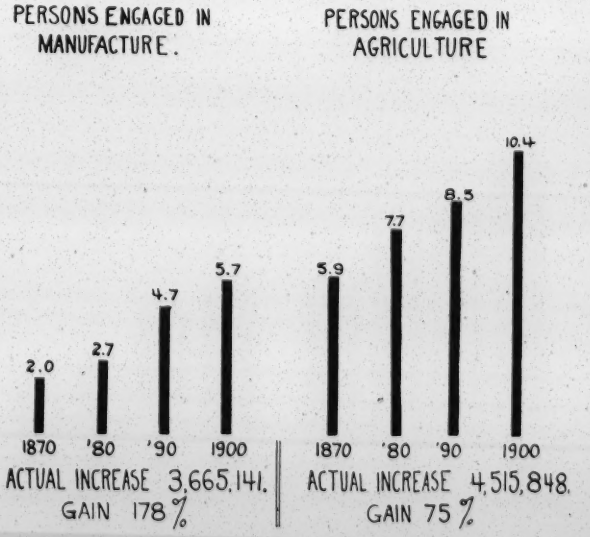


DIAGRAM NO. 5

No. 6.—VALUE OF PRODUCTS OF MANUFACTURING AND AGRICULTURE, RESPECTIVELY, 1870 TO 1900

The relative growth on the part of manufactures has also been more rapid than that of agriculture, since manufactures occupy a comparatively new field, while agriculture had pretty well developed the most productive sections prior to 1880, since which the manufactures have made their greatest gains.

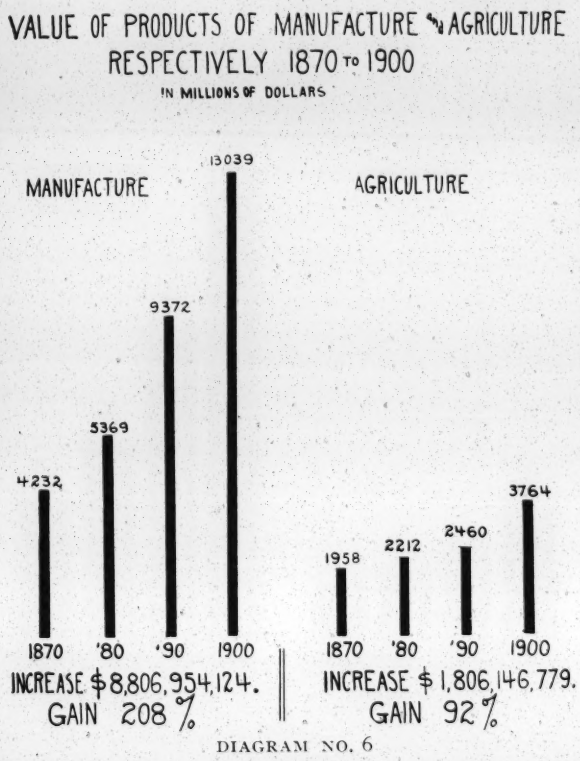


DIAGRAM NO. 6

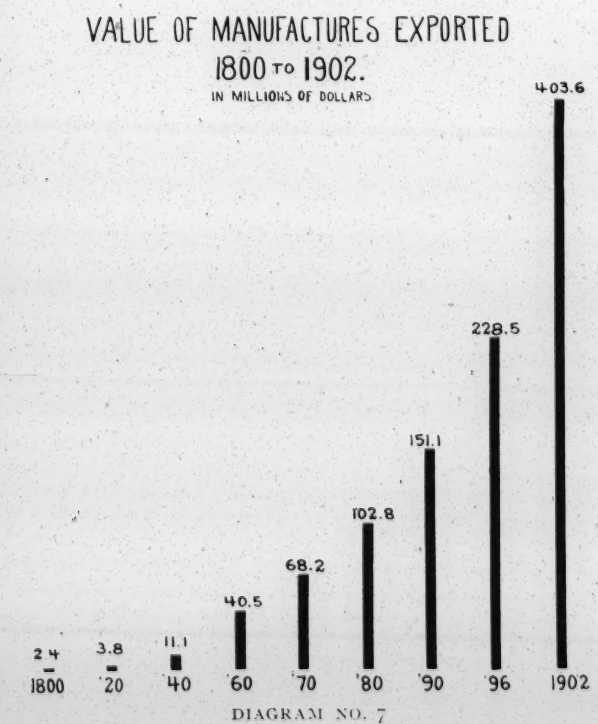


DIAGRAM NO. 7

The increase in the value of manufactured products from 1870 to 1900 was 208 per cent, while that of agricultural products was 92 per cent. I present these figures of total values of manufactures and agricultural products respectively merely for the purpose of showing the relative growth rather than relative value of product. A mere comparison of the aggregate value of manufactures with aggregate value of agricultural products would manifestly do injustice to agriculture, since, as already explained, the statement of the gross value of manufactures contains many duplications, while there are but few duplications in the statement of total products of agriculture. But a comparison to show the relative growth of the two industries, or the percentage of growth in each, seems not improper, since the duplications of value in the statement of total manufactures have existed in all census reports, and a fairly accurate estimate of the percentage of growth may therefore be had for use in comparing with the percentage of growth in agricultural products.

One especially interesting fact which the recent census developed is that our manufacturing industry draws 80 per cent of its raw material from farms of the country and actually utilizes one-half of the agricultural products of the country. The great cotton and woolen manufacturing industries obtain their raw material from the agriculturist, the material used by the manufacturer of leather originates on the farm or ranch, as do also those used in the manufacture of wines and liquors, the tobacco manufacturing industry, the milling and canning industries, and various other lines of manufacture. The census estimates that 80 per cent of the raw material used in manufacturing is the product of agriculture, and that 51 per cent of the value of the products of agriculture was purchased and used by the manufacturers of the country as raw material in

their manufacturing. This suggests the importance of the manufacturing industry to the farmer, to say nothing of the market furnished him by nearly 6 million people finding employment in the factories and workshops of the country.

No. 7.—VALUE OF MANUFACTURES EXPORTED, 1800 TO 1902

I want now to speak briefly of the effect of this increase in manufactures upon our foreign trade. Much has been said in recent years about the increase of our exports of manufactures, and quite justly, for the growth, especially in the past decade, has been very great. The growth of the entire century, taken as a whole, has been remarkable, but especially so in the past decade, as will be seen from this diagram, which shows that the exportation of manufactures in 1800 was about two and one-half million dollars; in 1840, 11 millions; in 1860, 40 millions; in 1880, 102 millions, and in 1890, 151 millions, but that in the short period from 1890 to 1902, only 12 years, the increase was nearly double that of the 90 years from 1800 to 1890, making the total exports of manufactures in 1902 403 million dollars.

No. 8.—PER CENT WHICH MANUFACTURES FORMED OF IMPORTS AND EXPORTS, 1820 TO 1902

It is not so much, however, in the power to supply foreign markets in which our manufacturers have made their great record as in their complete control of the home market among 80 million prosperous people. They have so fully supplied that market that they have steadily reduced the share which manufactures form of the imports, while they were also increasing the share which manufactures formed of the exports. This diagram shows the percentage which manufactures have formed of the imports and exports since 1820. The share which they formed of the imports has steadily decreased, from 44.9 per cent in 1820 to 16.6 per cent in 1902, and the share which they form of the exports has steadily increased from 7½ per cent in 1820 to 30.8 per cent in 1902.

No. 9.—DISTRIBUTION OF MANUFACTURES EXPORTED

Before leaving this subject, you will perhaps be interested to know what becomes of the manufactures which are

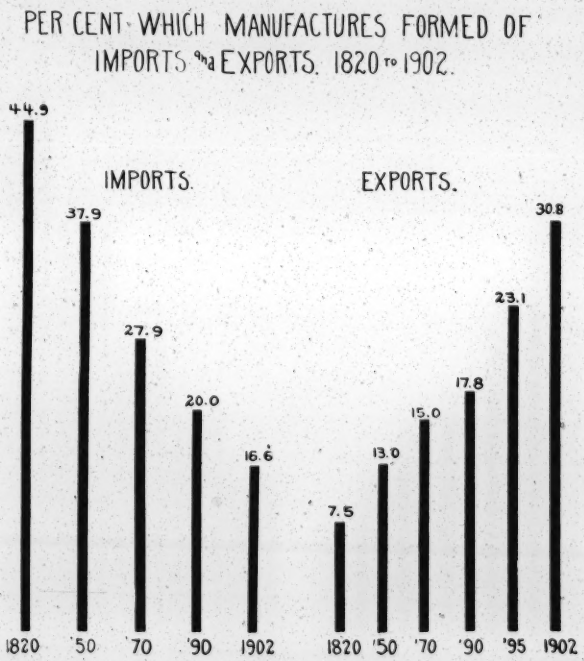


DIAGRAM NO. 8

exported from the United States. This diagram shows the distribution of manufactures by grand divisions. You will see that fully one-half of the manufactures exported goes to Europe, the greatest manufacturing center of the world. Of the 410 million dollars' worth of manufactures exported in 1901, 215 millions value went to Europe, 96 millions to North America other than the United States, 33 mil-

lions to Asia, 29 millions to Oceania, 27 millions to South America, and 10 millions to Africa.

No. 10.—VALUE OF MANUFACTURERS' RAW MATERIAL IMPORTED AND PER CENT WHICH IT FORMED OF TOTAL IMPORTS, 1820 TO 1902

Still another effect of this growth of our manufactures has been an increasing demand for the class of manufacturing material which we do not produce at home, such as fibers, rubber, silk, tin, chemicals and many other articles. This diagram shows the increase of manufacturers' raw materials imported since 1820. It will be seen that their total importation grew from 3 million dollars in 1820 to 61 millions in 1860, then suddenly increased to 160 millions in 1880 and 178 millions in 1890; but that the most remarkable growth has been in the years since 1890, the total having increased from 178 millions in 1890 to 327 millions in 1902, the gain in the 12 years since 1890 being nearly equal to that of the 70 years from 1820 to 1890. From the second group of lines it will be seen that manufacturers' raw materials, which formed less than 6 per cent of the imports in 1820, now form 36 per cent of the greatly increased total.

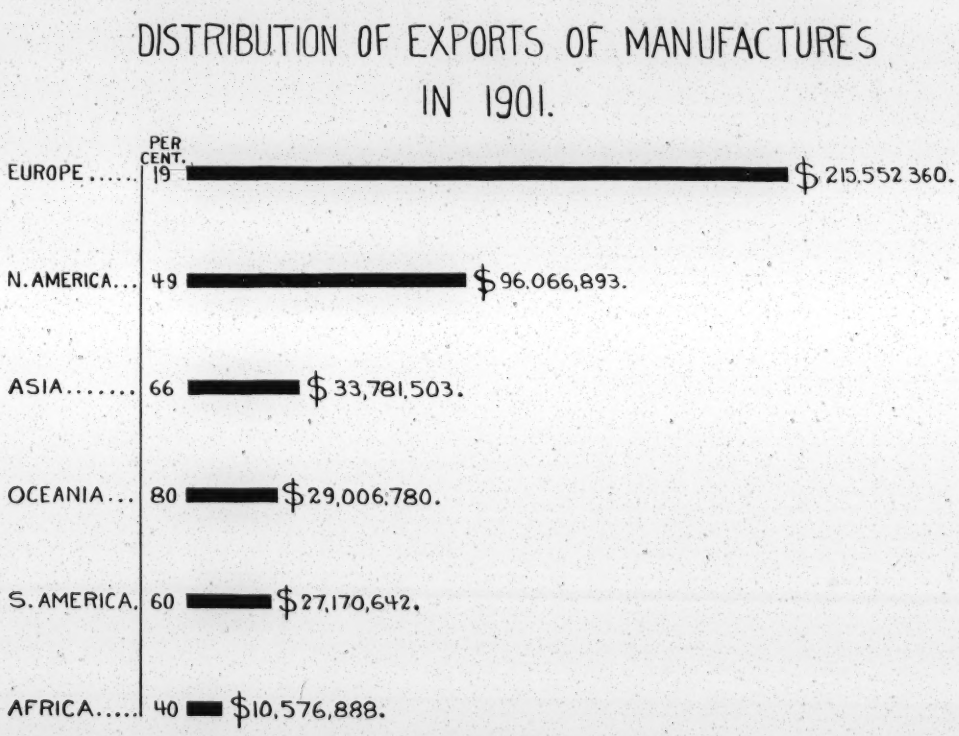


DIAGRAM NO. 9

No. 11.—RELATIVE VALUE OF MANUFACTURERS' MATERIAL AND ALL OTHER IMPORTATIONS, 1890 TO 1902

This shows the value of manufacturers' material imported in 1890, 1900, and 1902, and compares its value with that of all other imports. It will be seen that while manufacturers' material increased, the other imports decreased. Manufacturers' material increased from

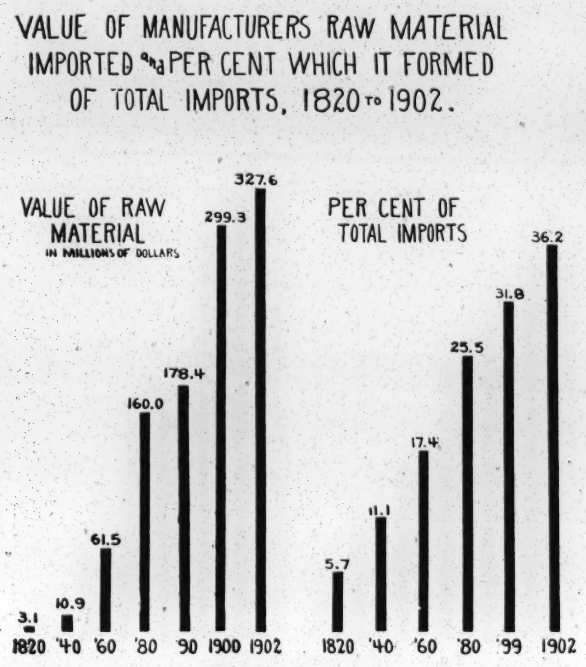


DIAGRAM NO. 10

265 millions to 420 millions, while the other importations decreased from 524 millions to 480 millions.

No. 12.—GROWTH OF DOMESTIC EXPORTS, AND SHARE WHICH MANUFACTURES FORMED OF THE SAME, 1870–1901

In this illustration the broken portion of the lines indicates the share which manufatures formed of the grand total. The diagram covers only the period from 1870 to 1901. A more extended statement, however, would show that exports of domestic manufactures formed in 1800 but 7.8 per cent of the total exports, and amounted to but 2½ million dollars, and that the growth in the first half of the century was extremely slow, having reached only 17½ millions in 1850 and forming but 13 per cent of the total exports. In 1875 the exports of manufactures amounted to 92½ million dollars and formed 16.5 per cent of the total exports, and in 1900 were 433 millions and formed 31.6 per cent of the total exports. In 1902 they were 403 millions in value and formed 29.7 per cent of the total, the reduction in 1902 as compared with 1900 being chiefly due to the excessive home demand for certain lines of manufacture, notably iron and steel.

No. 13.—GROWTH OF EXPORTS OF MANUFACTURES, AND SHARE WHICH IRON AND STEEL FORMED OF THE SAME, 1870–1901

In this illustration the broken lines show the share which iron and steel

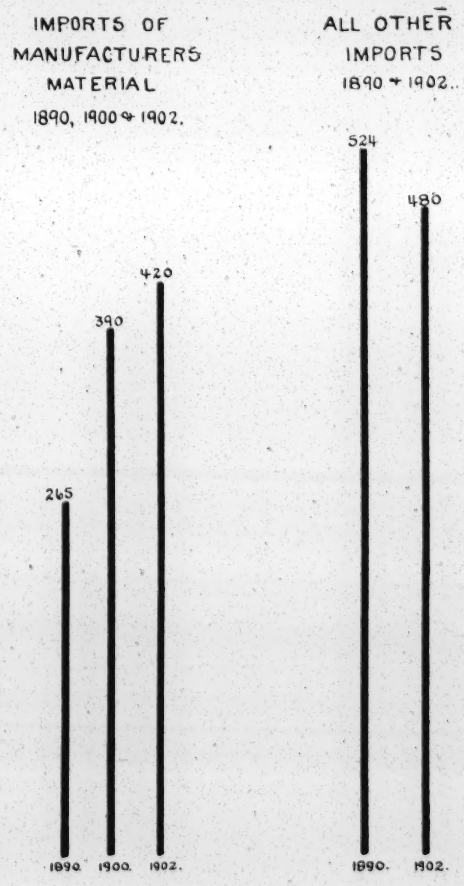


DIAGRAM NO. 11

formed of the total manufactures exported in each year from 1870 to 1901. The growth in the exportation of iron and steel manufactures has been phenomenally rapid, the total value of iron and steel exported being less than two million dollars in 1850, 9 millions in 1875, and 122 millions in 1900. For the fiscal year 1902 the total was 98½ millions, the reduction compared with 1900 being due, as already indicated, to the unusual home demand for iron and steel

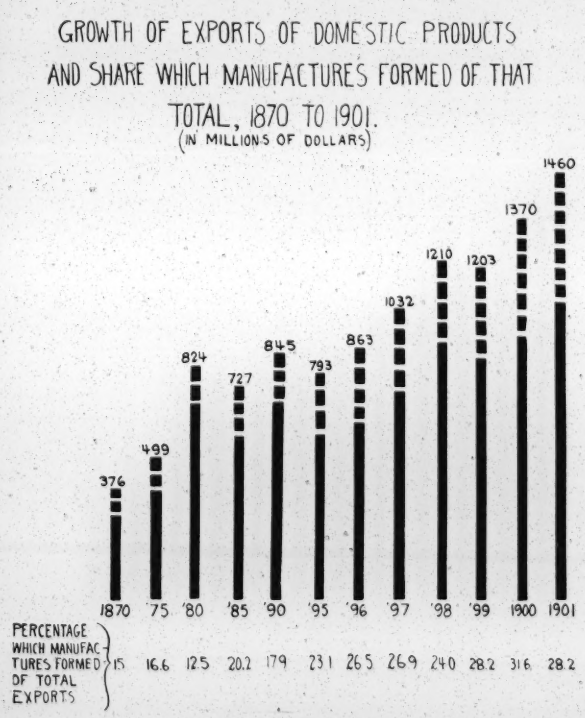


DIAGRAM NO. 12

manufactures for use in domestic industries, this demand being so great that the importations of iron and steel in 1903 exceed by far those of any year in the last decade.

No. 14.—EXPORTS OF MANUFACTURES OF IRON AND STEEL FROM 1870 TO 1901

This illustration shows the growth in exports of iron and steel manufactures during the period from 1870 to 1901, and illustrates the statements already made regarding the very rapid growth in this class of our manufactures. The United States has in recent years become the world's largest producer of iron ore and pig iron, her total production of pig iron in 1902 exceeding that of the United Kingdom, Germany, and Belgium.

No. 15.—PROGRESS IN THE PRINCIPAL MANUFACTURING INDUSTRIES FROM 1870 TO 1901

This diagram is intended to illustrate the growth in the production of the great articles which enter into manufactures, such as pig iron, cotton, and coal. The growth of coal production was from 32 million tons in 1870 to 261 millions in 1901; of pig iron, from 1,665,000 tons in 1870 to 15,879,000 tons in 1901, and over 18 millions in 1902. The growth of cotton manufactured at home was from 857,000 bales to 3,547,000 bales. The importation of the principal raw materials for use in manufacturing increased from 20 million dollars in 1870 to 176 millions in 1901—all illustrating the rapid growth in the manufacturing industries of the United States. The capital employed in manufacturing is shown by the census of 1870 at 2,118 million dollars, and that of 1900 at 9,874 millions, and the value of manufactures turned out in 1870, 4,232 millions, and in 1900, 13,040 millions.

Having now shown the growth in manufactures compared with conditions in our own country at the beginning of the centnry, I want to say a few words about the growth of manufactures in the United States compared with the growth in other countries, especially those great manufacturing countries of Europe—France, Germany, and the United Kingdom. These three countries produce practically two-thirds of the manufactures of all Europe, and therefore it seems unnecessary to take into consideration in this study the other and smaller

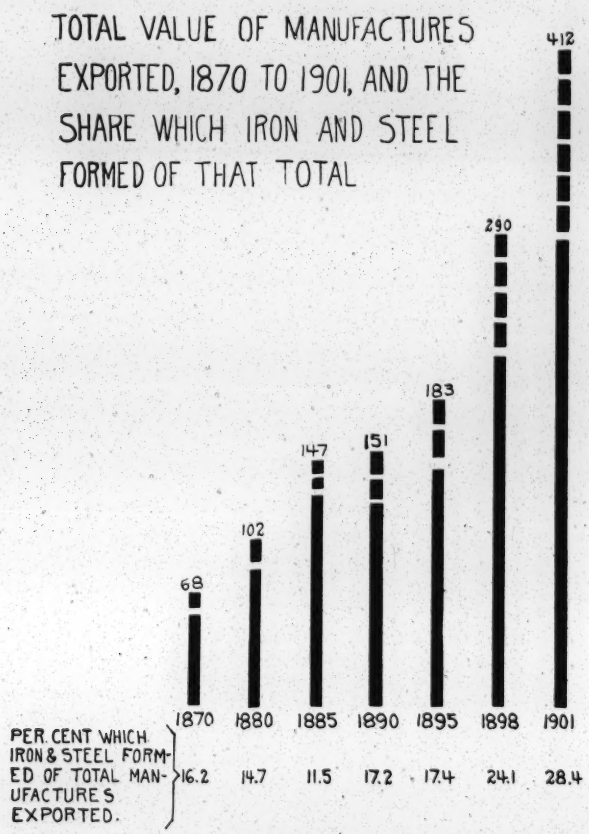


DIAGRAM NO. 13

countries. Curiously, even these old and well developed countries do not take as complete a census of manufactures as does the United States, and a comparison of growth year by year or even decade by decade is difficult. That distinguished statistician, the late Mr Mulhall, however, made shortly before his death some careful calculations on the value of the manufactures of the principal countries of the world, especially those of Europe, at various dates, and these are generally accepted as the best available information on this subject. I shall now show you by the same process which I have applied in the study of our own figures his statement of the value of manufactures in France, Germany, and the United Kingdom from 1840 to the close of the century, comparing their growth with that of the United States.

No. 16.—VALUE OF MANUFACTURES IN FRANCE, GERMANY, THE UNITED KINGDOM, AND THE UNITED STATES, 1840, 1860, 1888, AND 1894

In the four groups of lines shown you in this diagram is presented Mr Mulhall's statement of the relative value of manufactures produced in the four

DIAGRAM NO. 14

countries, France, Germany, the United Kingdom, and the United States, at the four dates which I have named, 1840, 1860, 1888, and 1894, the term "Germany" applying in the earlier periods to those States now included in the German Empire. The first group of lines indicates the value of the manufactures of each of the four countries in 1840 as shown by Mr Mulhall's figures, arranged in the order of magnitude, the United States the smallest, 467 million dollars, the European countries following in the order, Germany, France, United Kingdom. It will be seen that in 1840 the value of manufactures in the United States was less than one-third of those of Germany or France, and less than one-fourth of those of the United Kingdom. In the other groups of lines I have retained the same scale of measurement per million used in the first group, and the same relative position for each of the countries. In 1860 you will note that the United States had almost overtaken Germany and France, and that its manufactures were about two-thirds in value those of the United Kingdom. In 1888 the United States had outstripped all of her competitors in the race, the value of her manufactures, as will be readily seen, being more than those of France and Germany combined and nearly twice as great as those of the United Kingdom. In 1894, as will be seen by a glance at the final group of lines, the United States made still greater gains over her competitors, the value of her manufactures in that year being nearly as

PROGRESS IN THE PRINCIPAL MANUFACTURING INDUSTRIES
1870 - 1901.

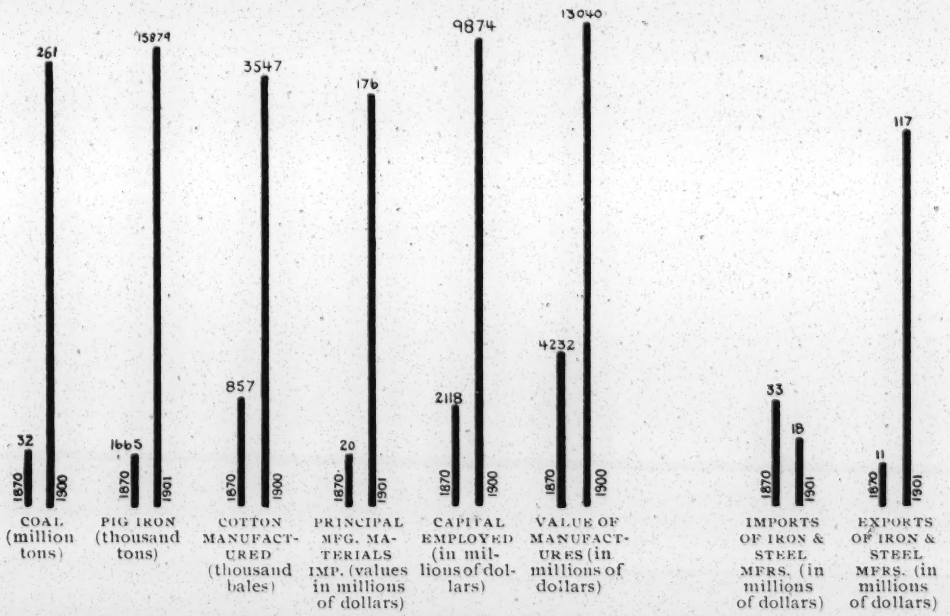


DIAGRAM NO. 15

great as those of France, Germany, and the United Kingdom combined.

No. 17.—GROWTH OF MANUFACTURES IN FRANCE, GERMANY, THE UNITED KINGDOM, AND THE UNITED STATES, 1840 to 1894

Before leaving this subject it may be interesting to note the actual rate of growth in manufactures in each of the four countries which have just been discussed, and I present in this diagram lines and figures which will show to the eye the actual growth in each country at the dates already named. The first group of lines relates to France, the second to Germany, the third to the United Kingdom, and the fourth to the United States. In France it will be seen that the growth has been steady, but not rapid, the increase being from $1,606,000,000 in 1840 to $2,900,000,000 in 1894, an increase of 80 per cent. In the case of Germany the growth was more rapid—from $1,484,000,000 to $3,359,000,000, an increase of 126 per cent. In the United Kingdom the growth was at about the same rate as that of Germany—from $1,883,000,000 to $4,263,000,000, also a gain of 126 per cent. In the United States the growth, it will be seen, was far more rapid than that of other countries—from $467,000,000 in 1840 to $9,498,000,000 in 1894, a growth of nearly 2,000 per cent. In other words, the manufactures of France in 1894 were scarcely double those of 1840; those of Germany, nearly two and a half times as great as in 1840; those of the United

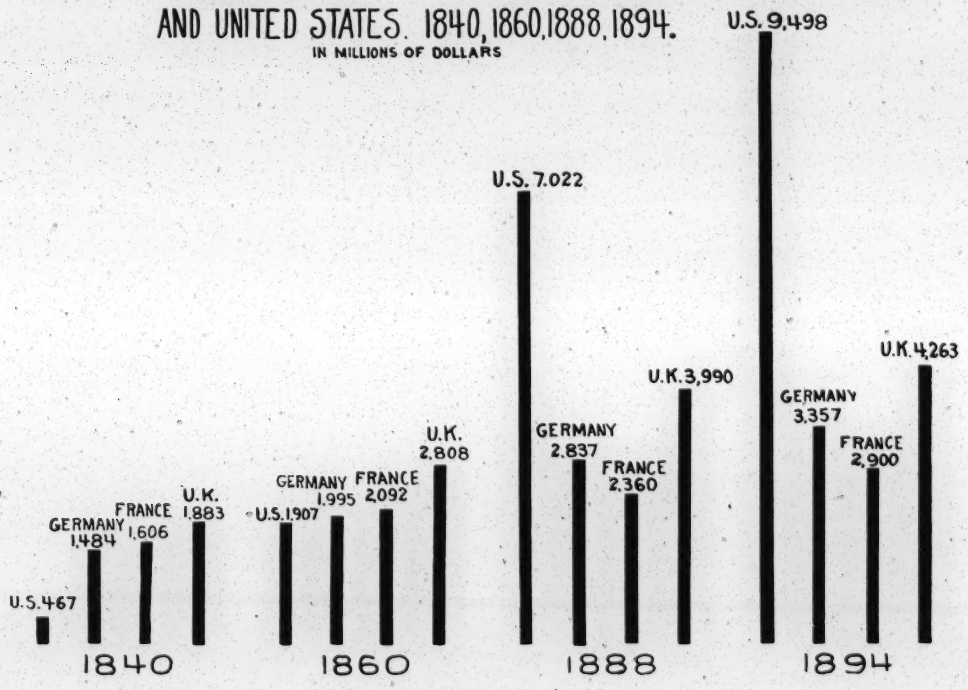


DIAGRAM NO. 16

Kingdom, nearly two and a half times as great as in 1840, and those of the United States practically twenty times as great as in 1840.

The causes of our rapid growth in manufactures, as compared with these European countries, are not difficult to find. The 5 great articles which enter most largely into the manufacturing industries today are iron, wood, copper, cotton, and coal, the latter being the important and necessary factor in transforming the others into manufactures. In each of these great requirements of manufacturing the United States has larger known supplies than any other country of the world, and better transportation facilities for assembling them for manufacturing. A few years ago the United Kingdom was the largest producer of pig iron; today we have not only far surpassed that country in the production of iron, but in 1902 our production of pig iron actually exceeded the combined production of the three greatest pig-iron-producing countries of Europe—the United Kingdom, Germany, and Belgium—and our production of steel exceeds that of other countries in a like proportion. Our production of pig iron has grown from less than one million tons in 1865 to over 17 millions in 1902, and of steel from 20 thousand tons in 1867 to over 13 million tons in 1901. Of copper the United States now produces one-half that of the entire world, our production of copper having grown from less than 1,000 tons in

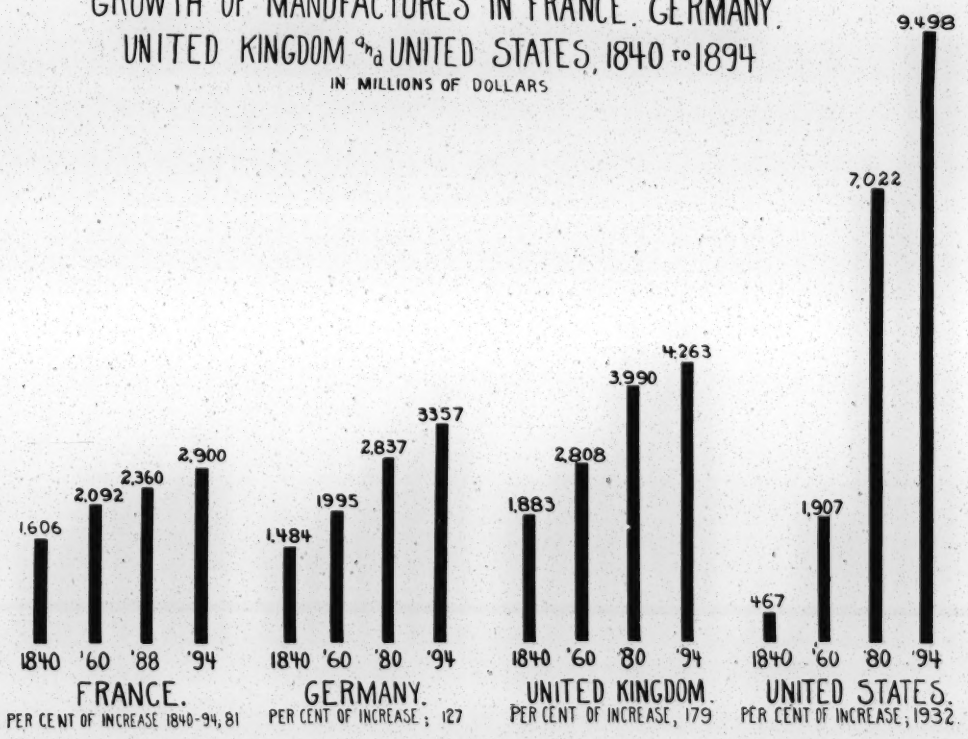


DIAGRAM NO. 17

1850 to 270 thousand tons in 1900. Of cotton, another important factor in manufacturing, our production has grown from three million bales in 1870 to an average of more than ten million bales per annum during the last five years, and the United States now produces three-fourths of the cotton of the world and turns one-third of that product into manufactures. Of timber the United States is the world's largest producer. Of coal, for use in assembling and transforming these articles into manufactures, the United States now produces more than any other country, her production having grown from 32 million long tons in 1870 to 261 millions in 1901. In transportation facilities, by which these products are assembled for manufacturing, railways have grown from 20,000 miles in 1856 to 200,000 miles in 1902, and are now two-fifths those of the entire world. Vessels passing through the Sault Ste. Marie canal have increased from 106 thousand tons register in 1855 to 25 million tons register in 1902, or nearly 20 times that passing through the Suez canal; and freight rates have fallen to about one-fifth those of 1860 and less than half those of 1880.

These comparisons of the growth in the production of the great staples required for manufacturing may be more readily and interestingly presented by some simple diagrams showing the relative growth in production in the United States and those countries which may be considered in any degree our competitors.

No. 18.—GROWTH OF COAL PRODUCTION IN THE UNITED STATES, UNITED KINGDOM, AND GERMANY, 1875 TO 1901

One of the important causes of the growth of our manufacturing is our plentiful coal supply and the ease with which it is produced. The United States now actually produces one-third of the entire coal supply of the world. The United States, the United Kingdom, and Germany produce three-fourths of the coal of the world, and I show in this diagram the growth of coal production in each of these three countries from 1875 to 1901. It will be seen that the United States and Germany started abreast in 1875, with a production of about 50 million tons each, but far below the United Kingdom, which

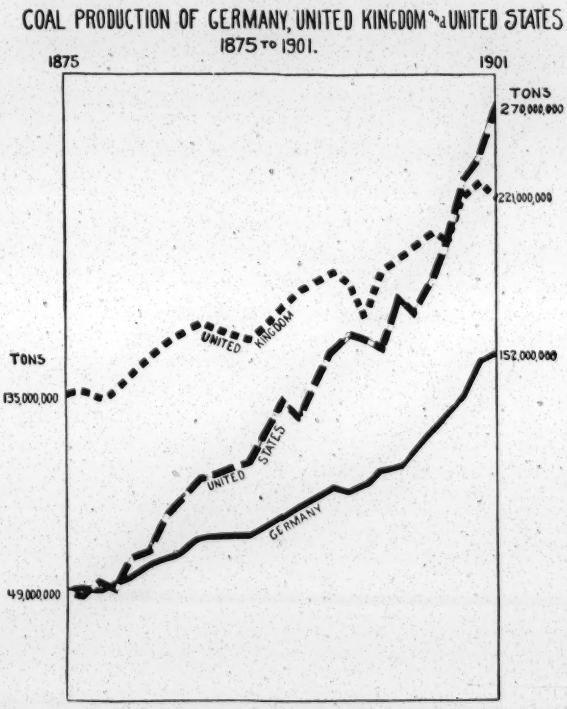


DIAGRAM NO. 18

produced about 135 million tons. The United States advanced much more rapidly than Germany, and in 1898 passed the United Kingdom, and is now sufficiently in the lead to assure that she will continue the greatest coal-producing country of the world. This assertion is fully justified by the fact that the area of our coal fields is 10 times as great as those of all Europe, and they

are only equaled in area by those of China, which must remain undeveloped until transportation facilities make their supplies available.

No. 19.—COAL PRODUCTION OF THE WORLD, 1870–1901

This diagram shows the growth in coal production of the world from 1870 to 1901. The first pair of lines shows the production of Germany in 1870 and 1901 respectively, the second pair the United Kingdom, the third pair the United States, and the fourth pair the remainder of the world. In the second group of lines is shown the increase in production from 1870 to 1901 in Germany, the United Kingdom, the United States, and the remainder of the world. It will be seen that the gain of the United States in that time was equal to that of Germany and the United Kingdom combined.

No. 20.—PIG-IRON PRODUCTION OF THE UNITED STATES COMPARED WITH THAT OF THE UNITED KINGDOM AND GERMANY

An equally important factor in manufacturing is the supply of iron and steel. I have already told you that the United States produces one-third of the coal of the world, and I may now add that she produces 30 per cent, or nearly one-third, of the iron ore of the world. Of iron and steel, as of coal, the three great producing nations of the world are the United States, the United Kingdom, and Germany. This diagram shows the growth of pig-iron production in the United States, United Kingdom, and Germany since 1877. It will be seen that the United States and Germany started abreast in 1877, far below the United Kingdom, and that in 1901 the United Kingdom and Germany were about equal, but with the United States so far above them that her output was

RELATIVE GROWTH IN COAL PRODUCTION IN GERMANY, THE UNITED KINGDOM, THE UNITED STATES AND ALL OTHER COUNTRIES. 1870 – 1901.

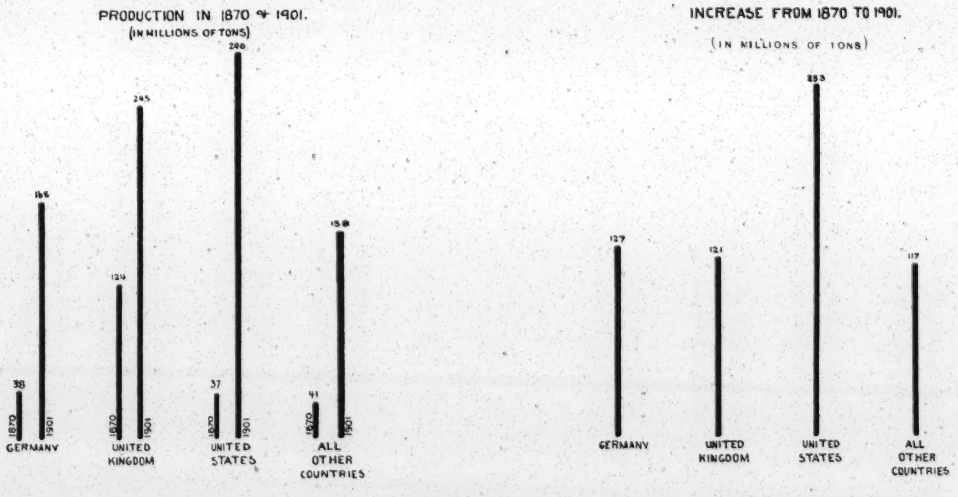


DIAGRAM NO. 19

actually equal to the combined production of the United Kingdom and Germany, and in 1902 was equal to both those countries, with Belgium thrown in for good measure.

No. 21.—STEEL PRODUCTION OF THE UNITED STATES, UNITED KINGDOM, AND GERMANY, 1877 TO 1901

In steel production the progress of the United States has been even more striking, compared with that of her chief competitors, than in iron or coal. The United States, United Kingdom, and Germany, it will be seen from this diagram, started nearly abreast in 1877, but the United States so far surpassed them that her production of steel is now not only greater than that of both combined, but is actually 44 per cent of that of the entire world.

No. 22.—COPPER PRODUCTION OF THE UNITED STATES COMPARED WITH THAT OF OTHER COUNTRIES

Copper, which was always an important metal, has become especially so in the recent years in which the use of electricity has so marvelously increased; and, as the demand for copper increased, the supply of the United States has so increased that she has not only outstripped all her rivals, but now produces one-half the copper of the world. The four principal copper-producing countries are: United States, Spain, Chile, and Japan. It will be seen from this diagram that while all these countries were nearly abreast in production in 1883, at the beginning of the world's great demand for copper, the United States immediately began her upward movement in production, while the other countries have made little change in their output. As a result we now produce as much copper as all the other countries of the world combined.

No. 23.—COTTON PRODUCTION OF THE WORLD, AND SHARE OF THE UNITED STATES IN THAT PRODUCTION

Another extremely important factor in manufacturing is cotton. Of this the

PIG IRON PRODUCTION OF GERMANY, UNITED KINGDOM & UNITED STATES 1877 TO 1901.

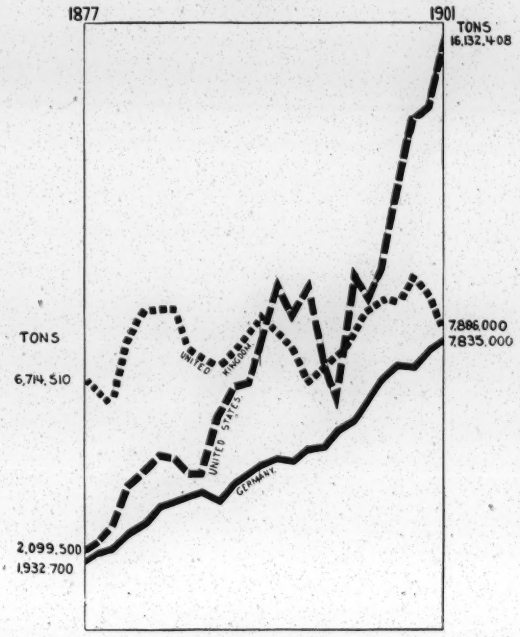
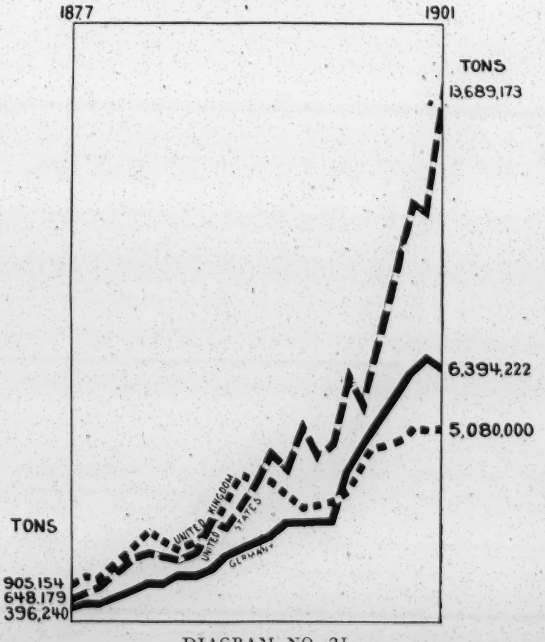


DIAGRAM NO. 20

STEEL PRODUCTION OF GERMANY, UNITED KINGDOM AND THE UNITED STATES 1877 TO 1901.



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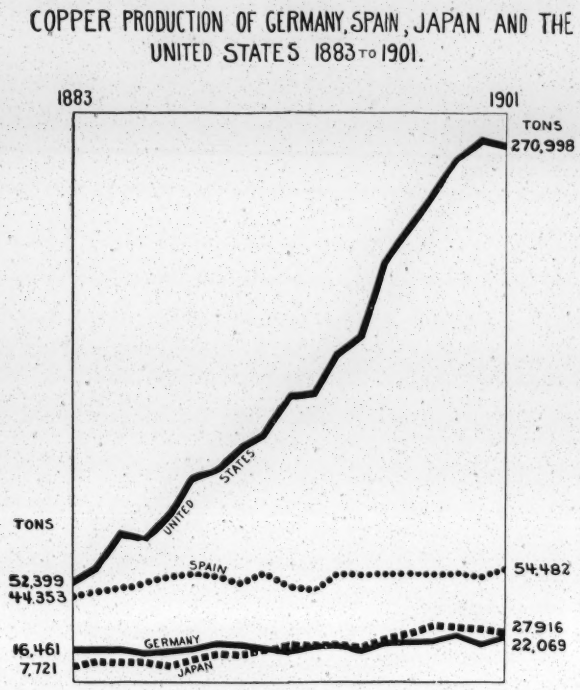

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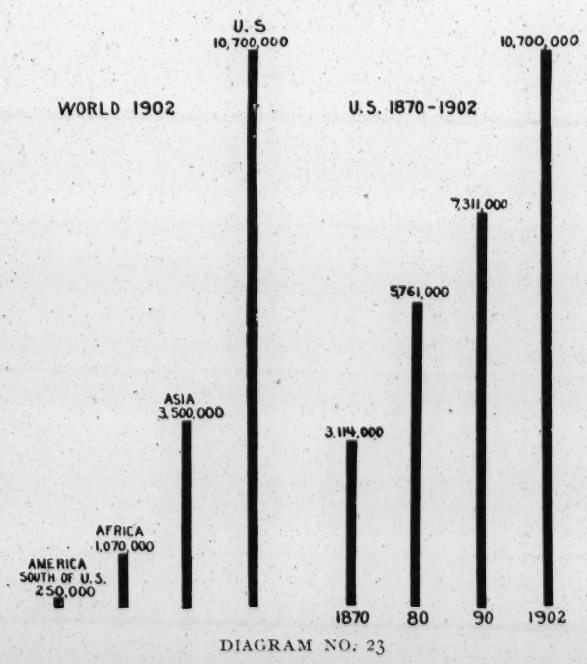


DIAGRAM NO. 23

United States produces practically three-fourths of the world's entire supply, and has doubled her production since 1880, and shown an ability to double the present product if the world demands it. This diagram shows the world's production of cotton in 1902. The first line is for all of America south of the United States; the second, Africa; the third, Asia; and the fourth, the United States. The second group of lines shows the production of the United States in 1870, 1880, 1890, and 1902, indicating the growth of production in response to the world's demands.

No. 24.—RAILWAYS OF THE UNITED STATES AND EUROPE, 1850–1902

While the production of raw materials is an important factor in manufacturing, the power of quickly and cheaply assembling those materials for actual manufacturing and of distributing them after manufacture is another important factor, and in this the United States surpasses all other nations. In this diagram I compare the railways of the United States not merely with those of a single country, but with those of all Europe. In 1850 our railways were two-thirds as great in length as those of Europe; in 1870, five-sixths as great; in 1880, nine-tenths, and in 1902 they actually exceeded those of all Europe by 12 per cent. The second group of lines shows the relative railway mileage of the United States in 1850, 1870, 1880, and 1902, and indicates the rapidity of growth.

I have now shown you, first, the increase in production of manufactures; second, the increase in production of raw material, and, third, the increase of transportation facilities. These three facts suggest that probably the manufacturing industries have extended far into the interior of the country, and especially to those sections where the raw material or the coal is produced, and an examination of the records of

the census shows that this is true. We are accustomed to think of the New England and Middle States as the chief seat of the manufacturing industries, and it is rather surprising to know that the center of the manufacturing industries has steadily moved westward until it is now located in the State of Ohio.

It is equally surprising to know that Ohio ranks first of all the States of the Union in the manufacture of carriages and wagons and of clay products, and second in agricultural implements and in iron and steel manufactures. Illinois holds first rank in the manufacture of agricultural implements, cars, bicycles, and distilled liquors, and second in men's clothing, furniture, musical instruments, soap, and candles. Wisconsin ranks first in lumber and timber production, Minnesota first in flour manufacturing, Missouri first in the manufacture of tobacco, Texas first in the manufacture of cotton-seed oil cake, Colorado first in lead, and California first in explosives, wines, and preserved fruits. The various manufacturing interests have extended far into the interior of the country, and in some cases across the entire continent.

While the plentiful supply of raw materials and unexcelled facilities for assembling them are perhaps the most striking among the causes of our manufacturing success, we must add another factor, the strenuousness of labor. This is one which we, as Americans, scarcely appreciate, because it is a condition to which we have always been accustomed; but that it has been an important factor in our success over other nations is evidenced by the attention which it receives from representative men of other countries who have studied our success and sought to learn its causes. Mr J. S. Jeans, secretary of the British Iron Trade Association, who recently accompanied a commission of iron and steel manufacturers sent to the United States to study conditions here, in his report says: "One of the notable characteristics of the principal cities and industrial centers of the United States is the comparative absence of a leisured class. The typical American appears to live only to work, and to work at something that will be a life-long career of usefulness to himself and the community. Every man, however rich, must have a calling in the United States." Mr Ludwig Max Goldberger, of Berlin, Royal Privy Councillor of Commerce and member of the Imperial German Consultative Board for Commercial Measures, who visited the United States in 1902, spending some eight months studying our commercial conditions, says: "A sort of fanaticism for work seems to have taken hold of men in the United States. Labor is so intense in the centers of industry

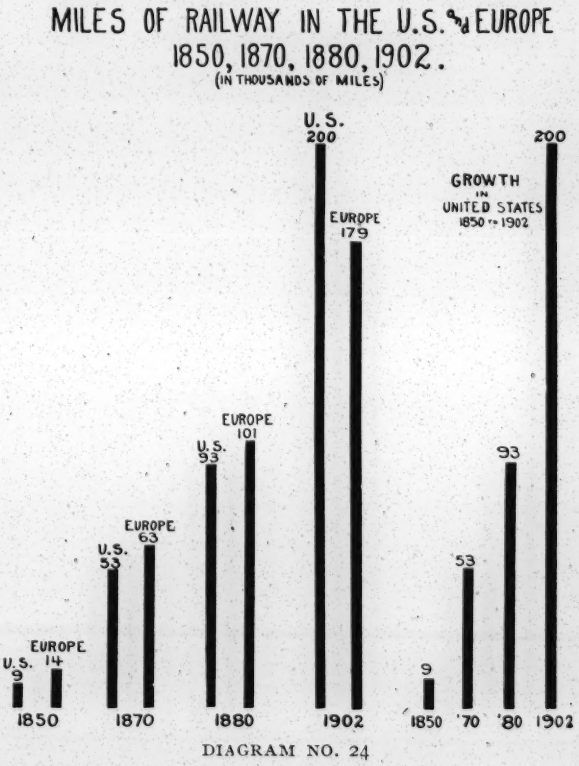


DIAGRAM NO. 24

that, barring sleep, it scarcely permits of any other recreation, and for that reason places of pleasure, if we except large towns, are very rare. The fanatical desire for work, of which I have just spoken, begins in early youth, and almost as young as the industries of the country are the leaders of large enterprises, many of them mere boys. On the other hand, there are few men who stop work and retire to live on their incomes, even when they have earned millions."

One other cause of our growth in production—and it is the last one which I shall suggest—is the greatness, the physical greatness, of our country. We do not realize, I think, how big we have grown. We proudly compare the growth of our manufacturing or exports with that of the United Kingdom, for example; but we do not, apparently, stop to consider that the area of England is less than that of the State of Kansas, and that of the entire United Kingdom less than that of Kansas and Nebraska combined. When we compare our own conditions with those of France, we forget that its area is less than that of our two Territories of Arizona and New Mexico combined. We look with complacency upon the figures which compare our growth in manufactures, commerce, and population with that of Germany, but overlook the fact that all of the German Empire is smaller than our single State of Texas. The area of the Thirteen Colonies, as defined by the Peace Treaty of 1783, was equal to that of the present United Kingdom, France, Germany, Norway, and Sweden, whose combined population today is 143 millions. The area added by the Louisiana Purchase is greater than the present area of Spain, Portugal, Italy, Austria, Hungary, and all of the Balkan States, with a combined population of 145 millions. The area added by the Florida Purchase is more than that of the present Denmark, Netherlands, Belgium, and Switzerland, whose population today is 18 millions. The combined area of the Texan, Mexican, Oregon, and Alaskan additions is nearly equal to that of all European Russia, whose present population is 106 millions. Thus, our present area, including Alaska, may be said to practically equal that of all Europe, whose population is in round terms 400 millions of people.

THE INTRODUCTION OF THE MANGO

THE great popularity of the mango among the natives of the Tropics, who in most places prefer the fruit to the orange or banana, recently led the U. S. Department of Agriculture to study the mango with a view of ascertaining whether it might not be made as popular among the people of the United States as the orange and banana. Great quantities of mangoes are grown in Porto Rico, and it occurred to the Department that if the fruit was such as would find favor among the American people, a profitable industry might be started on the island in exporting mangoes to the United States. Mr G. N. Collins, a specialist of the Department, was dispatched to Porto Rico to investigate the question. He found the mango one of the most common fruits in the island, and during the season when it is ripe, May to August, eaten in larger quantities than any others, with the possible exception of the banana, which is used more as a vegetable and cooked in one form or other. Unfortunately, most of the mangoes at present grown in Porto Rico are, however, too fibrous and coarse to ever become popular in

From G. N. Collins, U. S. Department of Agriculture

Grove of Mango Trees, between Cabo Rojo and Joyua, P. R.

the United States. The best varieties, which are rich and delicate, are scarce at present; but Mr Collins believes that in a very short time, with more care in the cultivation of the tree and with the introduction of new varieties of mango, great quantities of the finest fruit can be grown and shipped to this country. He believes that the fruit would soon become immensely popular and equal, if not surpass in popularity, both the orange and banana.

Mr Collins' report to the Department of Agriculture* has recently been published, and from it the following notes are taken:

Though European residents in the Tropics almost universally acquire a fondness for the mango, and in England the demand for it is steadily increasing, it having been found possible to make importations from India, notwithstanding the great distance, the mango is as yet little known in the United States, having been represented in our markets only by fruit of inferior varieties. These give no suggestion of the qualities of the better sorts, and tend rather to discourage than to increase the demand. If an effort similar to that which brought the banana into favor in the United States† could place an adequate supply of good mangoes before the public, there is no apparent reason why this new tropical fruit should not repeat the history of its now popular predecessor.

A taste for mangoes has in most people to be cultivated; but once acquired, it is like a taste for olives, and becomes almost a craving. The milder flavored varieties, in which no taste of turpentine is to be detected, are usually enjoyed even by the novice, but after one becomes familiar with the fruit a slight taste of turpentine ceases to be disagreeable. The fiber, however, that exists in the poorer varieties is an unmitigated evil, and renders the eating of a mango a serious operation. Persons forming their opinion of the fruit from these poor varieties usually indorse the proverbial statement that the mango is "a mass of tow saturated with turpentine;" but those acquainted with the fruit at its best are almost unanimously enthusiastic in their praise. Elphinstone, the historian of India, says:

"The mango is the best fruit of India, at once rich and delicate, and all other fruits are comparatively insipid beside its intensity of taste. There is something in it that is nothing less than voluptuous."

Good mangoes are produced in America, but as yet in such small quantity that few persons have had an opportunity to taste any but inferior fruit. Sample lots of the more common and poorer varieties are frequently shipped to northern markets, and have doubtless done much to hinder the growth of the trade. A first impression is very lasting, and first impressions of the mango based on such fruit are likely to be anything but favorable. As an example, mangoes are frequently to be found in the Washington market, but we have never seen one that could be called good, even in comparison with the Porto Rican fruit.

This impression will doubtless be difficult to dispel; but if really good mangoes could be placed in the markets their increase in popular favor would be certain and the growing of mangoes might become a profitable pursuit.

In spite of the fact that in all mango-producing countries the natives consider the fruit wholesome and perfectly safe, prejudice against it exists among some military officials and others, who con-

*"The Mango in Porto Rico." By G. N. Collins, Department of Agriculture, Bureau of Plant Industry, Bulletin No. 28.

†The banana was first introduced on a large scale into the United States by a steamship line which brought great quantities of bananas from the West Indies. It was not confidence in the latent popularity of the fruit that induced the steamship line to bring the bananas over, but a last effort to get freight for its vessels.

From G. N. Collins, U. S. Department of Agriculture

Branch of Mango Tree with Fruit, Tapachula, Mexico

From G. N. Collins, U. S. Department of Agriculture

Mango Fruit, showing Method of Packing

demn the fruit as positively dangerous. During the Spanish war this prejudice was so strong that the soldiers in Porto Rico were prohibited from eating the mango, and many beautiful trees were cut down. This prejudice probably arose from eating the fruit when unripe, in which state, like most other fruits, it is unwholesome.

In some parts of India the natives at one season of the year live almost exclusively on mangoes, apparently without harm. An extract from the Pharmacographia Indica, in Watt's Dictionary, describes the fruit as "invigorating and refreshing, fattening, and slightly laxative and diuretic."

The mango tree (*Mangifera indica*) varies in height, according to the variety, from little more than a bush to a tree 50 to 70 feet high, with a trunk 6 to 10 feet high and 2 feet or more in diameter. The leaves are lanceolate, about 1 foot in length, tapering gradually to a narrow point, with a smooth, shining surface. The young leaves are first pink, then red before turning green. The top is rounded and very dense. The bark is gray and smooth. The flowers are small, reddish-white, or yellowish, borne in large upright racemes. The fruit varies greatly, according to the variety. In some kinds it is not more than 2 or 3 inches in greatest diameter, while others are three or four times that size, some weighing as much as 4 pounds. In form they vary from nearly spherical to long and narrow like a cucumber, straight or crooked. The most common varieties are usually from 2 to 4 inches in length, more or less kidney-shaped, with the "nak" or stigmatic point more or less produced. In color they may be green, yellow, or red. In composition the difference is no less pronounced. In some the seed is large and the thin flesh between it and the skin consists almost entirely of fiber attached to the seed, while in others the seed is small, and in some so nearly aborted that it is

easily cut with a knife. In the best varieties the fiber is almost entirely wanting and the entire fruit consists of a mass of juicy, usually orange-colored pulp.

The Anacardiaceæ, to which the mango belongs, include also the turpentine tree (*Pistacia terebinthus*), the original source of turpentine, and it seems not at all unlikely that the characteristic odor of the mango is in reality due to the presence of turpentine or some closely allied substance. Exudations of a transparent resinous substance similar to that of the turpentine tree are frequently to be noticed in the mango.

The mango (*Mangifera indica*) is said by De Candolle to be native in South Asia or the Malay Archipelago, and recent authors report it as wild in the forests of Ceylon and the regions at the base of the Himalayas, especially toward the east, at an altitude of from 1,000 to 2,000 feet. Its culture is very ancient, as shown by references in Sanskrit mythology and ancient Hindu folklore.

For so old and so useful a plant, its distribution was comparatively limited until historic times. To the west it had not passed the Red Sea, being unknown in Egypt, while to the east it had apparently not reached the islands of the Pacific. The species is not well adapted for distribution by natural agencies, and man has probably been chiefly responsible for its dissemination.

In the New World it seems to have been first introduced into Brazil, although it is not known at what date.

The mango is now a common fruit throughout the Tropics of the world. It has been developed to the highest state of perfection in its home in India, where the number of well-marked varieties is enormous. Mr Maries, of Durbhungah, has collected over 500 varieties, 100 of which he characterizes as good. Thirty-four of these varieties he describes in Watt's Dictionary of Economic Products of India. Ceylon is also famous for its mangoes. Both the east and the west coasts of Africa have several good varieties. In Australia the culture is fast increasing, and it bids fair to become one of the most popular fruits. One very fine variety is said to exist in the island of St Helena. The mango is the most highly prized fruit of Guam, where there is a fine seedling variety. Its cultivation in that island is, however, not a success, owing probably to the thin soil, which affords such a shallow footing that the hurricanes uproot the trees in all exposed localities. In the Hawaiian Islands Mr William C. Stubbs* reports: "The mango is receiving perhaps more attention just now than any other fruit. As many as twelve or fifteen varieties have already been introduced. It is a delicious fruit, and decidedly ornamental in any ground." In the New World, Trinidad and Jamaica have the largest collections, although the drier regions of Central America and Mexico may be found to offer better seedling varieties.

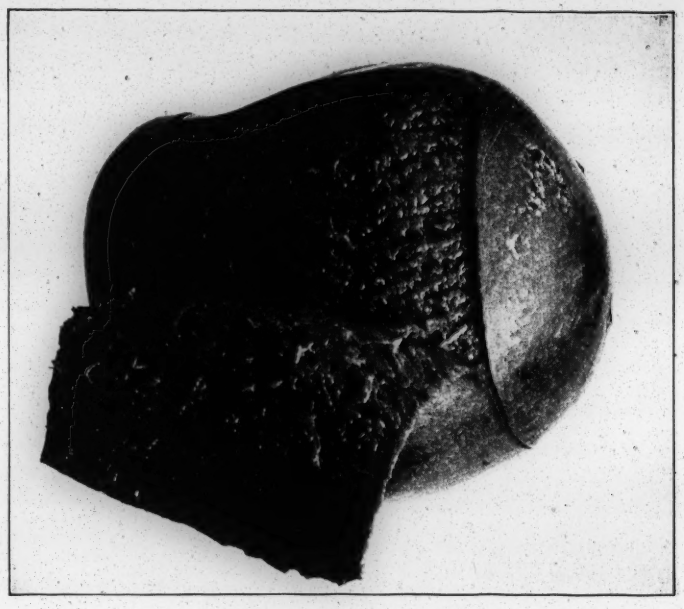
In spite of the many discouraging frosts that have visited Florida, planters of that state are actively engaged in propagating good varieties by budding, grafting, and inarching, and, if visited with no further misfortune, will in a few years produce considerable quantities of high-grade fruit.

The mango will grow in a variety of conditions, and it seems to have little preference as to soil, the most important requirement being a deep soil that is well drained. As to climate, it is much more exacting, and the fact that the tree may thrive well in a given locality and yet fail to produce fruit should be kept always in mind. The mango will be prolific only in regions subjected to a

* Bull No. 95, Office of Experiment Stations, U. S. Department of Agriculture, Report on the Agricultural Resources and Capabilities of Hawaii, p. 40.

From G. N. Collins

Mango Fork (full size)



From G. N. Collins, U. S. Department of Agriculture

Mango Fruit, showing Method of Peeling (natural size)

considerable dry season. On the moist north side of Porto Rico the trees grow luxuriantly, but they are not nearly so prolific, nor is the fruit of such good quality, as on the dry south side, and in the very dry region about Yauco and at Cabo Rojo the fruit seemed at its best, while its abundance was attested by the fact that fine fruit was selling as low as 12 for a cent. In Guatemala and Mexico the mango was found at its best only in regions where severe dry seasons prevailed.

Under favorable conditions the mango is very prolific. The tree of which a branch is shown on page 323 was estimated to have in the neighborhood of 5,000 fruits at the time the photograph was taken, and trees quite as prolific were seen near Cabo Rojo, Porto Rico; while trees in southern Florida before the freeze of 1886 were estimated to bear as high as 10,000 mangoes. From this it will be seen that with 25 to 100 trees per acre enormous quantities of mangoes can be produced on very small tracts of land, provided the right climatic conditions exist.

The method of peeling a stringy mango is shown on this page. A cut is made around either end of the fruit and these are then connected along one side, the central strip being peeled off in one piece. The skin remaining on the ends of the fruit affords a means of holding it without the fingers coming in contact with the juicy flesh. If in addition a sharp-pointed fork is at hand, this can be firmly

fixed in the seed and the skin at the ends removed, thus saving the sweetest part of the fruit. The illustration on page 326 shows a special mango fork secured in Mexico by Dr J. N. Rose. The long slender tine in the center easily penetrates the seed, and the shorter outer tines need only to touch the seed to prevent it from turning.

The best varieties of mango have hardly any fiber and the pulp is sliced with a knife, or sometimes is so soft that it is eaten with a spoon.

Porto Rico seems very well adapted to the production of mangoes and, as the plant is strictly tropical and very susceptible to cold, would seem to have a decided advantage over Florida, where good varieties are already successfully grown, but where, except in the extreme southern part, the danger of injury from cold is very great. A really high-grade mango is unknown in Porto Rico, and the first steps toward making their exportation profitable is the introduction from the other islands, or from Florida, Mexico, or the East Indies, of grafted stock of the best varieties.

The season of ripe mangoes in Porto Rico is from May to August. By selecting proper varieties this might be prolonged, since in some parts of India it extends over a period of six months. This would be a great advantage in shipping the fruit to temperate regions, as at present the season coincides with the season of temperate fruits, which places the mango at a decided disadvantage.

RAINFALL AND THE LEVEL OF LAKE ERIE

MANY people think that the rainfall, although differently distributed through the year, averages about the same one year as another, or if there is a deficiency one year, it will be made up the next. With this erroneous notion in mind, those concerned with navigation on the Great Lakes have naturally looked for some other explanation of changing water levels, for from 1888–1901 they witnessed a period of low water so long it seemed unreasonable to expect it ever to attain its former level. However, a comparison of the level of Lake Erie, as shown by the gage at Cleveland, with the record of rainfall along the Great Lakes shows a complete correspondence.

The high water in Lake Erie in 1902 and the heavy rainfall of that year are fresh in the minds of those who live near it.

The Weather Bureau established a number of stations on the Great Lakes in 1870. The first marked deviation from normal level in Lake Erie after this was in 1872, when the water was lower than for many years before or after. The rainfall that year was below the normal at every station on the Great Lakes. (I have taken no account of stations on Lake Ontario.) In 1876 the water was higher than for many years before and higher than any year since. The rainfall was above normal at all stations except Marquette, where it was nearly an inch below. At Milwaukee the excess was 18.28 inches; at Grand Haven, 11.52; at Detroit, 8.07.

In 1878 the lake was considerably higher than the preceding or following year. The rainfall was a little below normal at Duluth and Grand Haven, but above at all other stations, being 60.24 inches at Buffalo, where the normal is only 38.04, and 53.51 at Cleveland, where the normal is 36.29.

In 1882 the lake was higher on an average than in any other year since 1876. The rainfall was below normal at Buffalo, Detroit, and Milwaukee, but

above normal at the ten other stations, the excess at most of them being greater than the deficiency at any of these three.

In 1890 the water was higher than in the years immediately preceding or following. The rainfall was not far from normal on the upper lakes, but above normal at all Lake Erie stations.

In 1895 the water was the lowest for half a century, and the rainfall on the Great Lakes probably the least, certainly the least recorded at the Weather Bureau stations since their establishment.

These include all the years that differ in any marked degree from those that precede and follow.

If we consider parts of years we find also a close agreement between rainfall and lake level. Examination of the monthly record of lake level at Cleveland led me to think the rainfall at the different stations must have been below normal for the first half of 1888 and the last three months of 1887. On consulting the record I found it so. To exactly account for the stage of the water during brief periods, of course several things must be considered—surplus or deficiency in the different lakes at the beginning of the period, time required for water to flow from the upper lakes, evaporation, melting of snow on the watershed, whether ground is frozen, whether rain falls gradually or so fast that a larger portion passes quickly into the streams.

Most of the time since 1887 Lake Erie has been lower than for many years before. The rainfall has also been less, as the table shows. If any one could tell us when this dry cycle will give place to a wet one, the information would be highly appreciated. Perhaps the wet one has already begun. At any rate, those concerned need not fear any appreciable lowering of Lake Erie below its level in the past decade from any other cause than drouth. I believe that people now at Cleveland, Toledo, Detroit, Milwaukee, and Chicago will live to see the water higher than their fathers ever saw it. The same cannot be said of places on Lake Huron or the northern part of Lakes Superior and Michigan, for the slow tilting of the earth's crust is such as gradually to lower the water in those regions.

MEAN ANNUAL RAINFALL ON THE GREAT LAKES

Station.	Year established.	Mean in inches to December 31, 1887	Mean since 1887.	Mean deficit since 1887.
Duluth.....	1870	32.8	27.0	5.8
Marquette....	1871	32.3	32.4	—0.1
Chicago.....	1870	36.7	30.5	6.2
Milwaukee....	1870	33.2	28.5	4.7
Grand Haven.	1871	38.9	30.4	8.5
Alpena.....	1872	37.9	29.7	8.2
Port Huron...	1874	33.5	29.3	4.2
Detroit.....	1870	33.6	30.7	2.9
Toledo.....	1870	32.7	28.0	4.7
Sandusky....	1877	37.5	31.5	6.0
Cleveland.....	1870	37 4	33.1	4.3
Erie.....	1873	43.2	35.2	8.0
Buffalo.....	1870	38.1	36.8	1.3

E. L. MOSELEY.

GEOGRAPHIC NOTES

THE RAILROADS AND FORESTRY

THE Bureau of Forestry has continued this year on a far larger scale the experiments in timber seasoning and preservation for the railroads which it began last year under Dr Hermann von Schrenk. This work will be done for the New York Central, the Erie, the Baltimore and Ohio, and the Pennsylvania railroads in the East, and for the Illinois Central, the Santa Fé, the

St Louis and San Francisco, the Missouri, Kansas and Texas, the Northern Pacific, and the Burlington in the South and West.

The scarcity of valuable timbers is felt by no class of consumers more keenly than by the railroads, which use every year 110,000,000 ties merely to renew those worn out and decayed. The price of timbers has risen in some instances to a figure which makes their use prohibitive ; in other cases the supply is so nearly exhausted that the roads have been compelled to look about for new timbers.

The Bureau of Forestry has been called on to assist in solving the difficulty, and has come forward with the very practical and simple suggestion that the railroads, instead of continuing to use expensive, high-grade timbers for such a low-grade purpose as that of railroad ties, shall use the cheaper woods. For example, to the complaint of the New York Central that it finds it more and more difficult to secure longleaf pine ties from Georgia at the price it can afford to pay, the Bureau suggests that the road use the beech, maple, and birch of the Adirondacks. The complaint that the timbers rot very quickly when laid in the ground is answered by the suggestion that they should be seasoned and preserved, just as beech is seasoned and preserved in France. The Great Eastern Railroad of France has succeeded in making beech ties last 35 years by impregnating them with tar oils. The unseasoned longleaf pine ties used by the New York Central last only five years ; and the beech, if laid green, without seasoning or preserving, would in many cases last no more than three years. The substance of the proposal which the Bureau has made to the railroads, and which the railroads have thought so well of as to adopt, is that experiments be made to determine whether cheaper timbers may be treated with preservatives at a cost so low and be made to last such a long time that it will pay to substitute them for the more expensive timbers now employed.

The railroads have thought so well of these ideas that they will not only carry on under the Bureau's direction the necessary experiments in seasoning and preserving, but have engaged the Bureau's help in learning where cheap timbers for ties may be obtained. In other words, the railroads have decided that if they can be convinced that it will pay to season and preserve cheap timbers for ties, they will acquire large areas of timber lands on which they will grow their own trees, cut their own ties, and thus be assured of a steady supply. This means that some of the great railroads of the country are in a fair way to practice forestry on a very large scale, and to employ a great many foresters.

Work of a similar nature to the railroad experiments is being carried on for the American Telephone and Telegraph Company, which used last year 150,000 telephone poles and 3,000,000 feet of timber in cross-arms. Seasoning experiments are being conducted on chestnut telephone poles near Harrisburg, Pa., and on cedar poles near Wilmington, N. C.

Important and valuable as this work is to the railroad and telegraph companies, it is of far greater importance and value to the country at large. The use of cheaper timbers for railroad ties is in several ways an economic saving; it relieves the high-grade timbers of a part of the heavy demand that is being made upon them, opens a market for timbers for which there is now little sale, and affords splendid opportunities for conservative management of timber lands. The work is being prosecuted according to the regular cooperative system of the Bureau, by which the field and traveling expenses of the Bureau's agents are paid by those for whom the work is done.

New York, October 17, 1902.

Commander Robert E. Peary, U.S.N.
Washington, D.C.,

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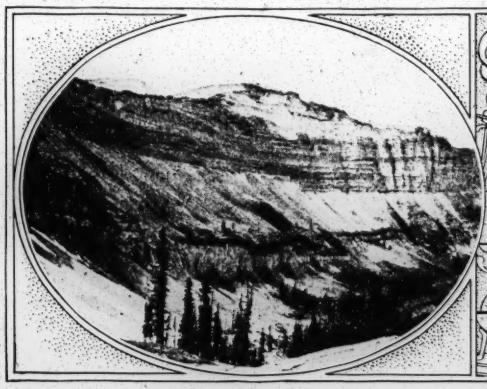

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